

Electronic Supporting Information

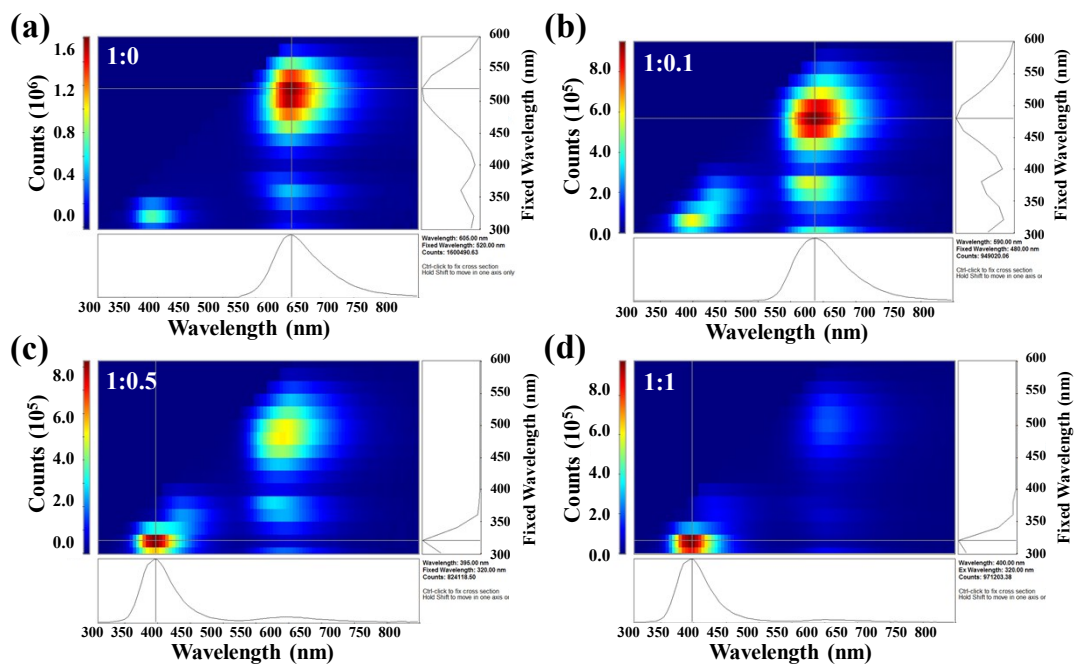


Figure S1. Contour plot of the photoluminescence spectra of the four different CDs samples with precursor ratio of (a) 1:0, (b) 1:0.1, (c) 1:0.5, and (d) 1:1, respectively.

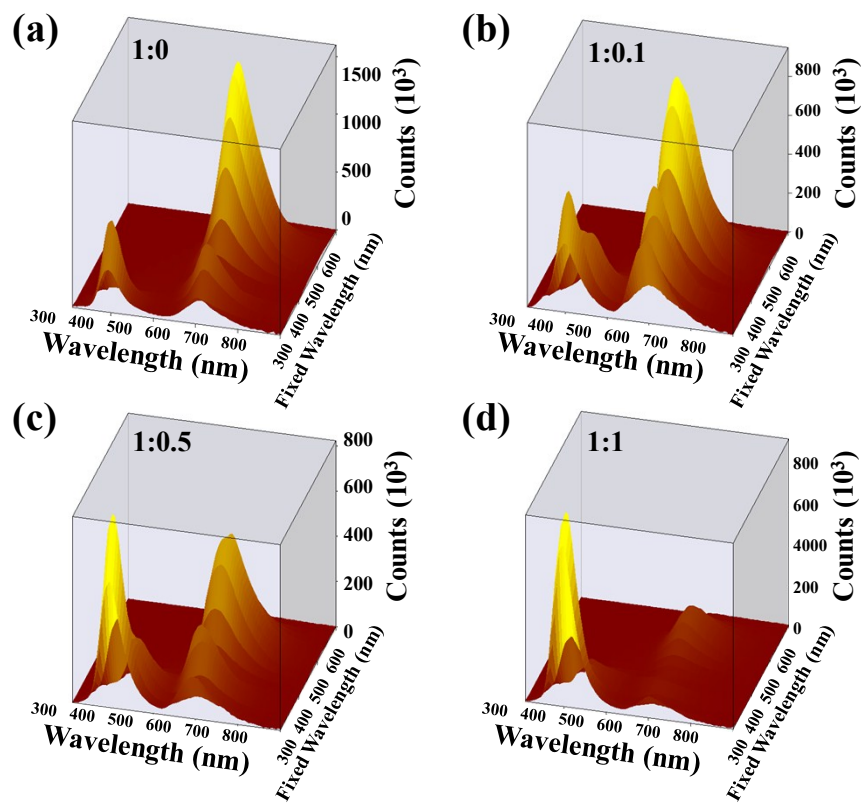


Figure S2. 3D plot of the excitation spectrum and emission spectra of the four different CDs samples with precursor ratio of (a) 1:0, (b) 1:0.1, (c) 1:0.5, and (d) 1:1, respectively.

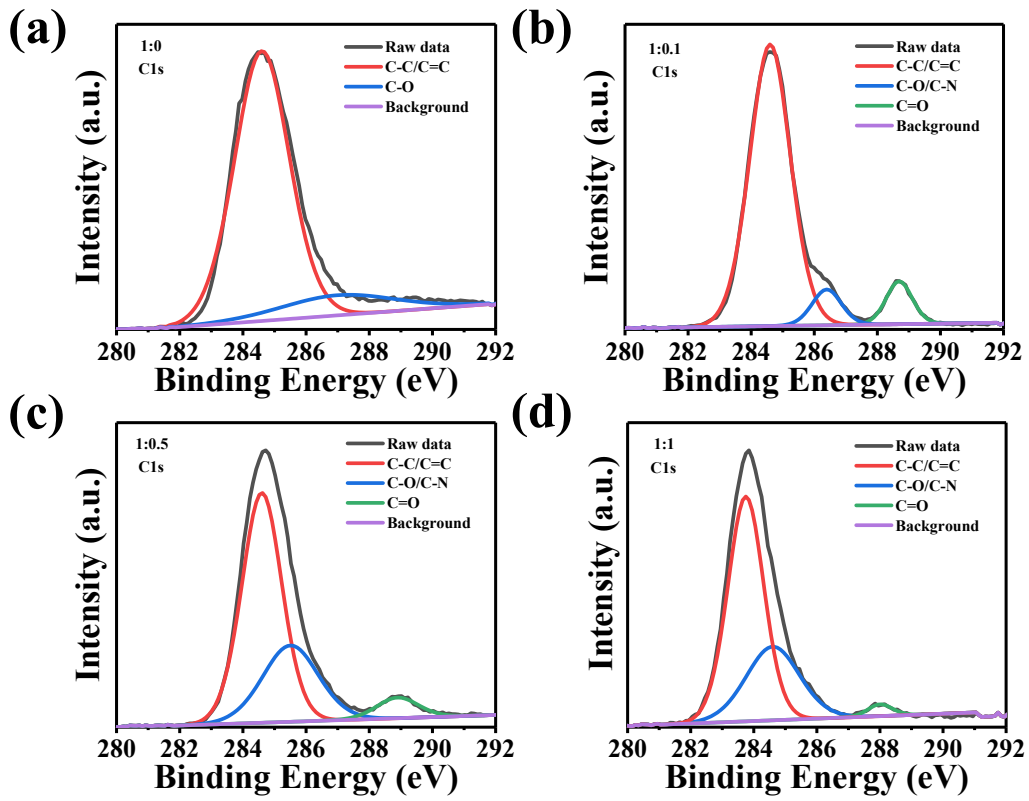


Figure S3. High-resolution C 1s XPS spectra for the four different CDs samples with precursor ratio of (a) 1:0, (b) 1:0.1, (c) 1:0.5, and (d) 1:1, respectively.

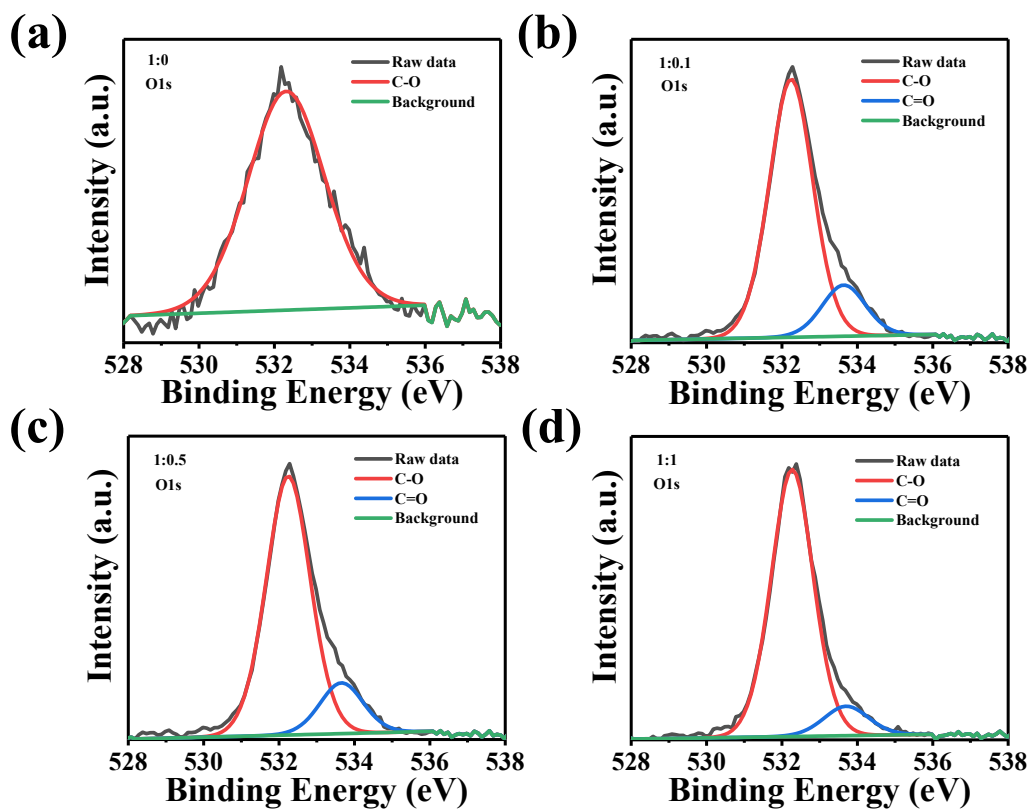


Figure S4. High-resolution O 1s XPS spectra for the four different CDs samples with precursor ratio of (a) 1:0, (b) 1:0.1, (c) 1:0.5, and (d) 1:1, respectively.

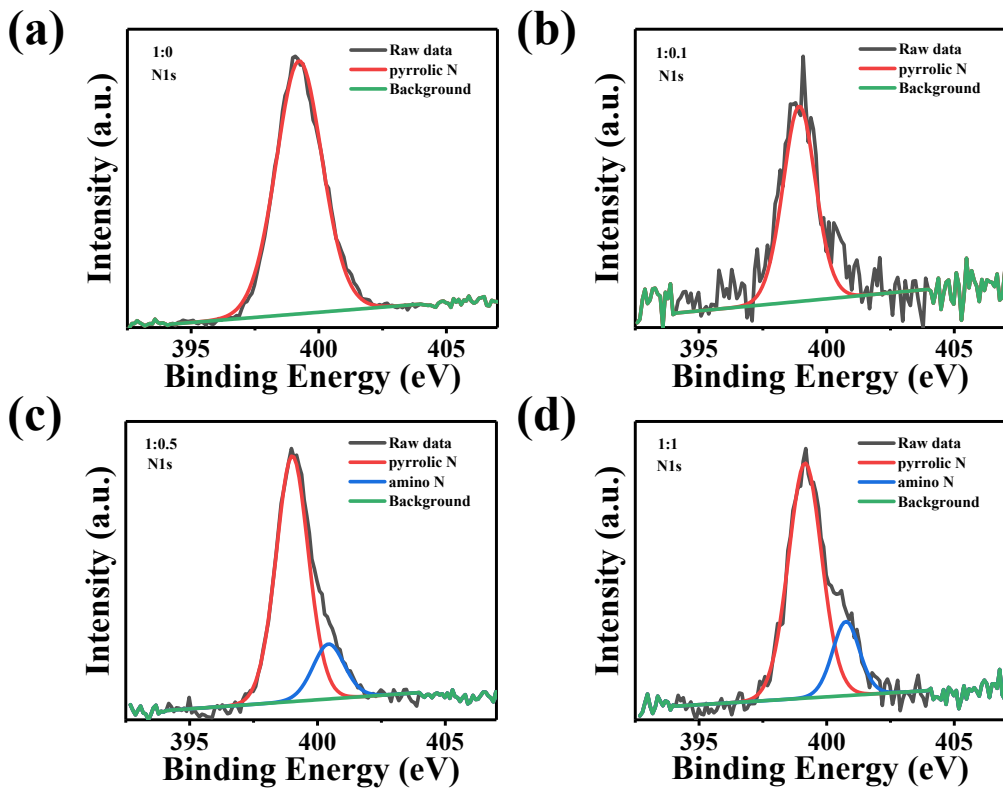


Figure S5. High-resolution N 1s XPS spectra for the four different CDs samples with precursor ratio of (a) 1:0, (b) 1:0.1, (c) 1:0.5, and (d) 1:1, respectively.

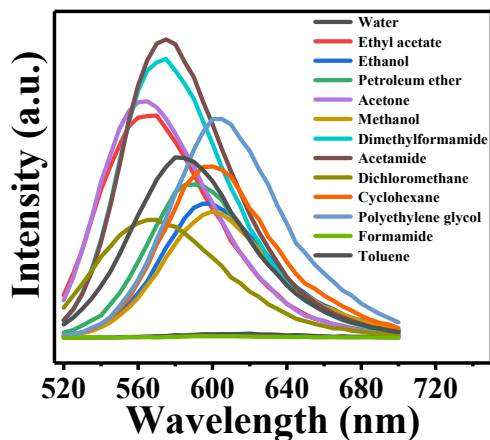


Figure S6. Fluorescence spectra of 30 μL of CDs sample with precursor ratio of 1:0 diluted into 3 mL using different common solvents.

Table S1. Content of various elements in the four different CDs samples with precursor ratio of 1:0, 1:0.1, 1:0.5, and 1:1, respectively.

Ratio	C	O	N	Zn
1:0	76.35	4.42	19.23	0
1:0.1	76.76	21.66	1.58	0.09
1:0.5	74.62	19.59	5.62	0.18
1:1	73.45	16.29	10.01	0.25

Table S2. Content of oxygen containing functional groups in the four different CDs samples with precursor ratio of 1:0, 1:0.1, 1:0.5, and 1:1, respectively.

Ratio	C-C/C=C	C-O/C-N	C=O
1:0	86.65	13.35	0
1:0.1	84.07	8.24	7.69
1:0.5	64.26	29.70	6.04
1:1	65.68	31.96	2.36

Table S3. Content of carbon containing functional groups in the four different CDs samples with precursor ratio of 1:0, 1:0.1, 1:0.5, and 1:1, respectively.

Ratio	C-O	C=O
1:0	100	0
1:0.1	83.47	16.53
1:0.5	83.83	16.17
1:1	89.50	10.50

Table S4. Content of nitrogen containing functional groups in the four different CDs samples with precursor ratio of 1:0, 1:0.1, 1:0.5, and 1:1, respectively.

Ratio	pyrrolic N	amino N
1:0	100	0
1:0.1	100	0
1:0.5	82.01	17.99
1:1	79.55	20.45

Table S5. Radical effect on the HOMO-LUMO energy gap of CDs.

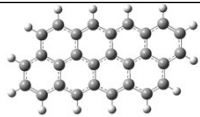
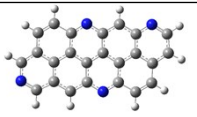
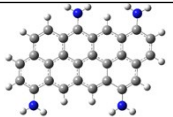
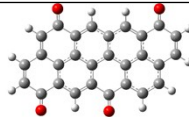
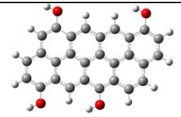
	HOMO-LUMO energy gap (eV)			
2.18	2.31	1.86	2.73	2.01
				

Table S6. CDs with different radical and their HOMO-LUMO energy gap.

CDs models	Number of radical or doped atom on CDs					HOMO-LUMO energy gap(eV)
	Zn	Pyridinic N	Amino N	-C=O	-C-O	
a	0	0	1	1	2	0.90
b	0	1	0	1	2	1.02
c	1	1	0	1	2	0.71
d	1	0	1	1	2	1.10
e	2	0	2	2	1	0.91
f	2	2	0	2	1	1.17